

On the Application of the New Data Model of eCl@ss

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1. Problem statement

Product classification standards like eCl@ss, UNSPSC, etc. provide definitions of product categories and properties for describing product instances. Classification standards often consist of more than 10,000 classes, several thousand properties, and an even greater number of class-property relations. The problem is that maintaining these standards becomes more and more difficult especially when classes and properties are not harmonised – and when the number of classes grows. And the number of classes really grows, since classes are more and more differentiated according to various applications.¹

Table 1 shows basic figures for six versions of eCl@ss

	V4.0	V4.1	V5.0	V5.1	V5.1.1	V6.0
Publication Date	Aug. 2001	Sep. 2002	Dec. 2003	Sep. 2004	Sep. 2005	Apr. 2008
Commodity Classes	10,190	12,565	20,379	21,100	22,203	32,590
Properties	2,303	5,504	3,667	5,525	6,941	10,930

Table 1: Growth of Classes and Properties in eCl@ss²

¹ c.p. Joerg Leukel, (2003): Controlling Property Growth in Product Classification Schemes: A Data Management Approach. University of Hohenheim, Stuttgart, Germany. Pg. 1

² c.p. Joerg Leukel, (2003): Controlling Property Growth in Product Classification Schemes: A Data Management Approach. University of Hohenheim, Stuttgart, Germany. Pg. 4

As shown in the paper on “Entropies in the Classification of Commodities – a Challenge for E-Commerce”³, eCl@ss is dealing with a growing number of similar classes like *screws* for example. There exist is number of classes which describe different kinds of screws,⁴ e.g. cortical screw, spongiosa screw, special screw, wood screw, etc. These classes have some properties in common, others are unique for specific areas of application. We could show that many classes are not well developed – a core property like *screw length* for example is missing in the property list of for example a *cortical screw*. And across all segments of eCl@ss many classes are only described by the basic properties shown in the table below.

No.	Basic property sets
1	BAA001002 - Manufacturer name
2	BAD847002 - Manufacturer product number
3	BAA316002 - Product name
4	BAA002002 - Product type description
5	BAA059002 - Supplier product number

Table 2: Five basic properties (default properties) of eCl@ss

Today in eCl@ss property sets for similar classes are not harmonised, often many properties are missing. The assignment of individual properties to individual classes is a bottleneck for the harmonisation of properties. Today we have an uncontrolled growth of classes and properties in eCl@ss. That is very risky for the further development of eCl@ss.

In this paper we show how the full application of the new data model of eCl@ss can help to solve these problems. Today, eCl@ss provides only a categorisation hierarchy for classes. We propose to introduce an additional class hierarchy which specialises products and provides for inheritance of properties from a global class to specialised classes. We use Class hierarchies are introduced, starting with the ‘General Application Classes’,

³ Reusch P., Garcia E., Communication of the Scientific Advisory Board of eCl@ss No 1 (2008): On Entropies in the Classification of Commodities - a Challenge for E-Commerce.

⁴ More details available in: Garcia, E. (2009): Harmonisation of property sets in critical commodity classes of eCl@ss, Project Thesis, European Master in Project Management, Dortmund/Bilbao. Pg. 48-62

‘General Commodity Classes with General Properties’, and organise the properties in these classes according to independent ‘Aspects’ (administrative, technical, etc.). The inheritance of properties along this class hierarchy reduces the assignments of individual properties to individual classes significantly – and help to develop eCl@ss more efficiently.

2. The Existing Data Model

Currently, eCl@ss provides four levels of classes: segments, main groups, groups and commodity classes. Figure 1 illustrates the four hierarchical levels of eCl@ss classification system.

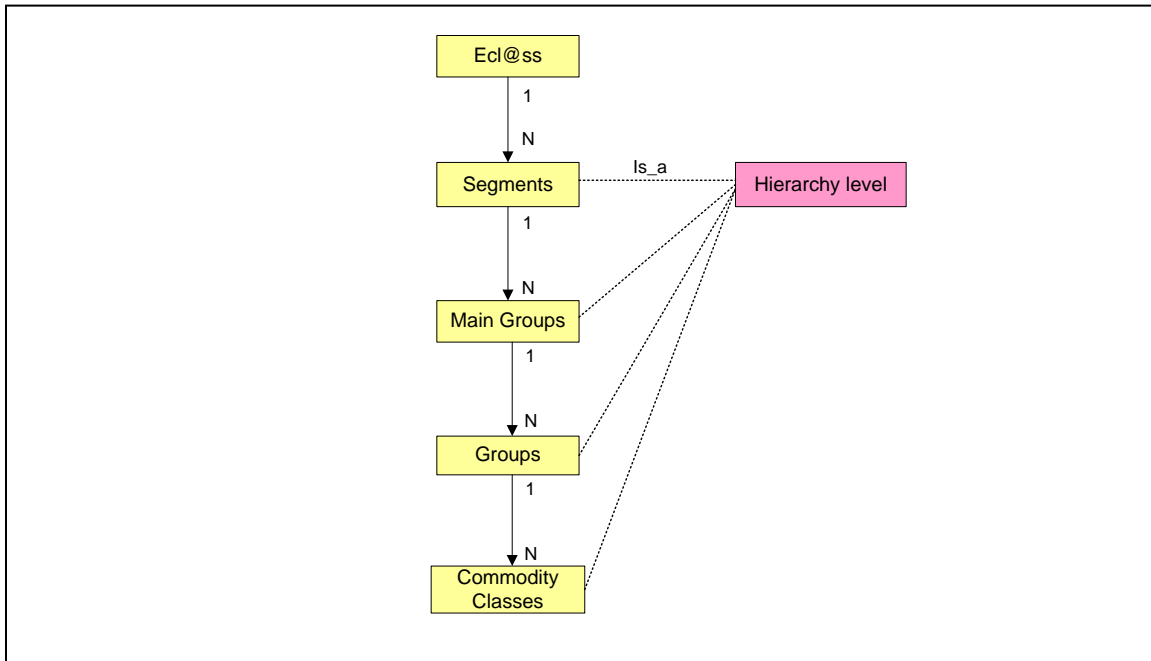


Figure 1: Hierarchical level of eCl@ss⁵

The relation between eCl@ss and segment (first level) is 1 : N. This means that eCl@ss has one or more segments.

The same kind of relation exists between segments and the attached main groups, between main groups and groups, and finally between groups and commodity classes.⁶

⁵ cp. Hesselmann, Klaus., Ondracek N. Paradine (2006): Strategiepapier Neues Datenmodell eCl@ss. Version 1.5 pg. 19

⁶ More details available in: Garcia, E. (2009): Harmonisation of property sets in critical commodity classes of eCl@ss, Project Thesis, European Master in Project Management, Dortmund/Bilbao. Pg 32-34

3. The New Data Model

The new data model of eCI@ss extends the concepts which can be used for capturing structures of classes and properties. Figure 2 gives an overview about the main elements of the new data model and gives some high level relationships between them (please note: Figure 2 is not a formal data model).

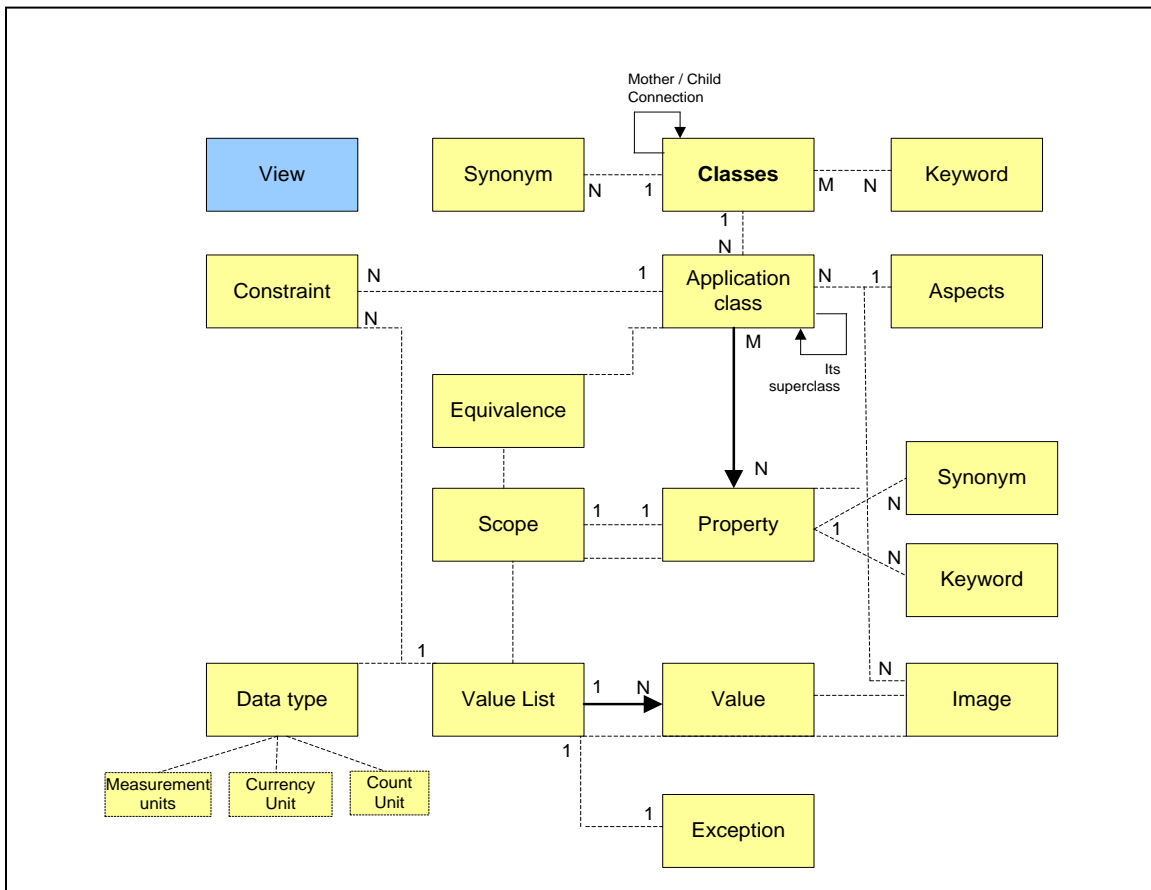


Figure 2: New Data Model of eCI@ss⁷

⁷ c.p. Koziel, G. and Ondracek, N. (modified a bit by Wilkes, W), (2008-07): Data Structure V6.0, ppt (slide 9)

The main components of the new data model which are important for this paper are the following:

- **Class Hierarchy**

eCl@ss uses logical categorisation to classify commodity classes into four levels: ‘segments’, ‘main group’, ‘groups’ and ‘commodity classes’. The classes in this hierarchy do not contain properties – thus the hierarchy is inheritance free. This permits the construction of a hierarchy under technical, business or other aspects.

- **Application Class**

Application classes contain the properties. They also may be organised in a hierarchy. But different to the categorisation hierarchy, this hierarchy is based on the concept of property inheritance. An application class may currently be connected to exactly one commodity class.

- **Property**

In general, properties provide identifiers and descriptions, define object features (such as colour, size, weight, etc.), or define object behaviours (such as whether an object is enabled). According to ISO 13584-42, “a property is characterised by the following elements: Unique identifier (BSU), definition class, domain, descriptive information”.⁸ Products are described by specifying values for these properties.

- **Aspect**

In the new data model properties can be categorised by means of “aspects”. Beside the technical core properties which describe the product technically, aspects allow the specification of different view points by which a product can be described, e.g. prize view, and administrative view, etc.

⁸ CEN Workshop Agreement (2006): “Product Description and Classification - Part 1:New Property”
Ref. No.:CWA 15556-1:2006 E LibraryPg 6

- **Keyword**

“Keywords support the search within the eCl@ss class structure and must not have exactly the same meaning as the preferred name (e.g. class: pliers, keyword: pipe pliers)”.⁹

- **Synonym**

“Synonym is a word or an expression that serves a figurative or symbolic substitute for another word.”¹⁰ In the context of the data model, synonyms are used to describe the same or nearly the same meaning of commodity classes and properties.

- **Data type**

“Data type is an attribute of the property that defines the type of the property.”¹¹

“Each property has a domain which defines the data type of the property. The data type specifies the set of allowed values for this property in product descriptions.”¹²

- **Value**

“A property can have values which determine the most useful characteristics of the property (e.g. property: colour, value: red). The sum of all values of a property is called a set of values.”¹³

⁹ “Quick guide for eCl@ss-change requests” version 1.0 in:
Kurzanleitung_fuer_eClass_Aenderungsantraege_v1.0_en.pdf pg. 1

¹⁰ www.freedictionary.com

¹¹ Koziel, G. and Ondracek, N. (modified a bit by Wilkes, W), (2008-07): Data Structure V6.0, ppt (slide 15)

¹² CEN Workshop Agreement (2006): “Product Description and Classification - Part 1:New Property”
Ref. No.:CWA 15556-1:2006 E LibraryPg 6

¹³ “Quick guide for eCl@ss-change requests” version 1.0 in:
Kurzanleitung_fuer_eClass_Aenderungsantraege_v1.0_en.pdf pg. 1

4. Application of the New Data Model

4.1 First Step

As described in the introduction, a number of similar products are organised in various classes which are scattered across the current eCI@ss hierarchy. The reason is that they have been organised according to their respective industry branch: For instance, screws can be found in a branch of machine element devices (*e.g. 23-11-01-01 Hexagon head cap screw*), as well as in the branch of medical devices (*e.g. 34-32-17-01 Cortical Screw*). But there does not exist any means by which these classes are related to each other, and in particular, there is no possibility to share properties across these classes.

With the new concept of application classes which carry properties and which may build inheritance hierarchies, this is now possible. The basic idea is the building of a second hierarchy which allows to factor out common properties of similar classes into a more abstract class. This idea is illustrated in the figure below:

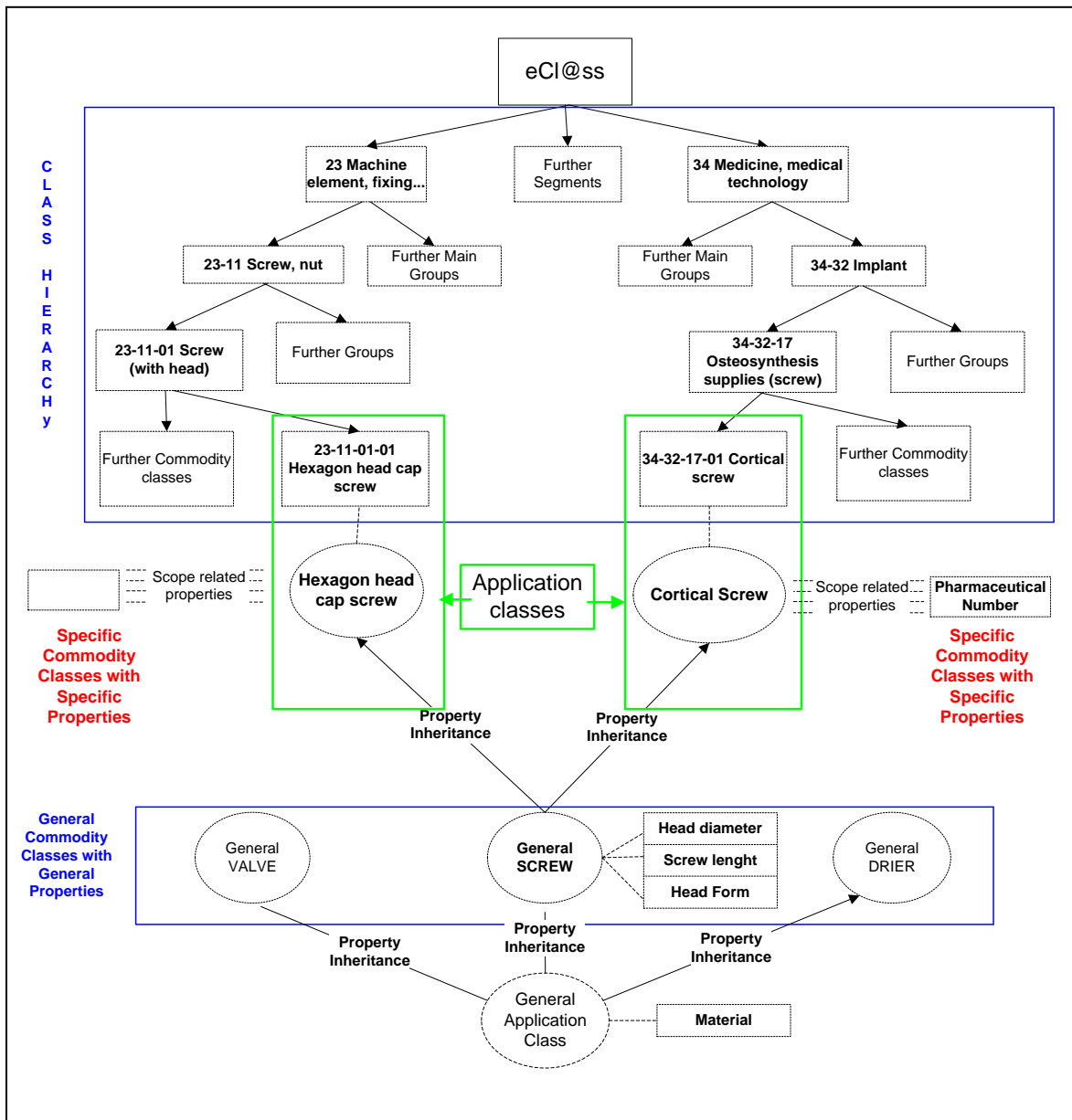


Figure 3: eCI@ss Data Model (Application classes)

Figure 3 illustrates that there exist bottom up a **General Application Class**, **General Commodity Classes** with General Properties and **Specific Commodity Classes** with specific properties. Classes are linked by inheritance. For example to describe uniquely the commodity class *Cortical Screw* there exist properties like 'Material' which are related to the General Application Class. These properties belong not only to the commodity class 'Screw' but also to other classes like 'Valve' or 'Drier' etc.

Properties defined for the **General Application Class** are inherited to more specific application classes. Properties like, for example, 'Head diameter', 'Screw length' or 'Head form' are defined for the **General 'Screw'** application class and are inherited to the 'Cortical Screw' application class for example. The 'Cortical Screw' application class is distinguished by specific properties like for example 'Pharmaceutical Number'.

Inheritance is a way to reduce the assignment of properties to classes, to harmonise properties, and to extend property lists for commodity classes.

Figure 4 shows filters to steer the inheritance and exclude not applicable options in the next level.

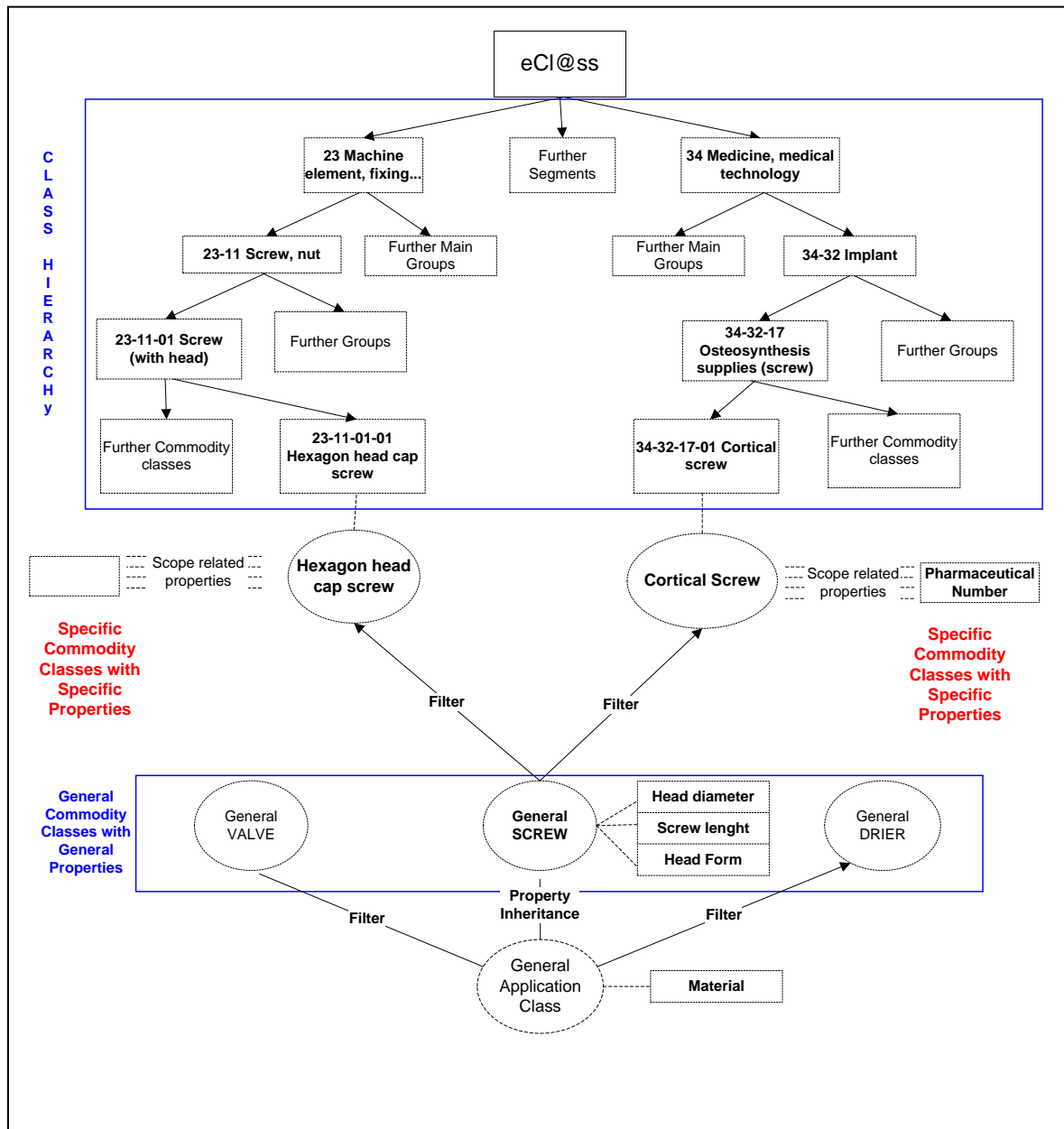


Figure 4: eCI@ss Data Model (Filter)

4.2 Second step

In the first step the application of the new data model focused of typical industrial applications. For services and other kinds of applications we need additional general application classes.

Services have typical properties like duration, object of provision, personnel qualification, etc. Such properties are candidates for a general application class for services.

The general application class we used in section 4.1 can be redefined as a general application class for industry.

From the general application classes for industry and for services we can take out some common properties like product name, manufacturer name, etc.

Figure 5 introduced the additional level in hierarchy.

Second step

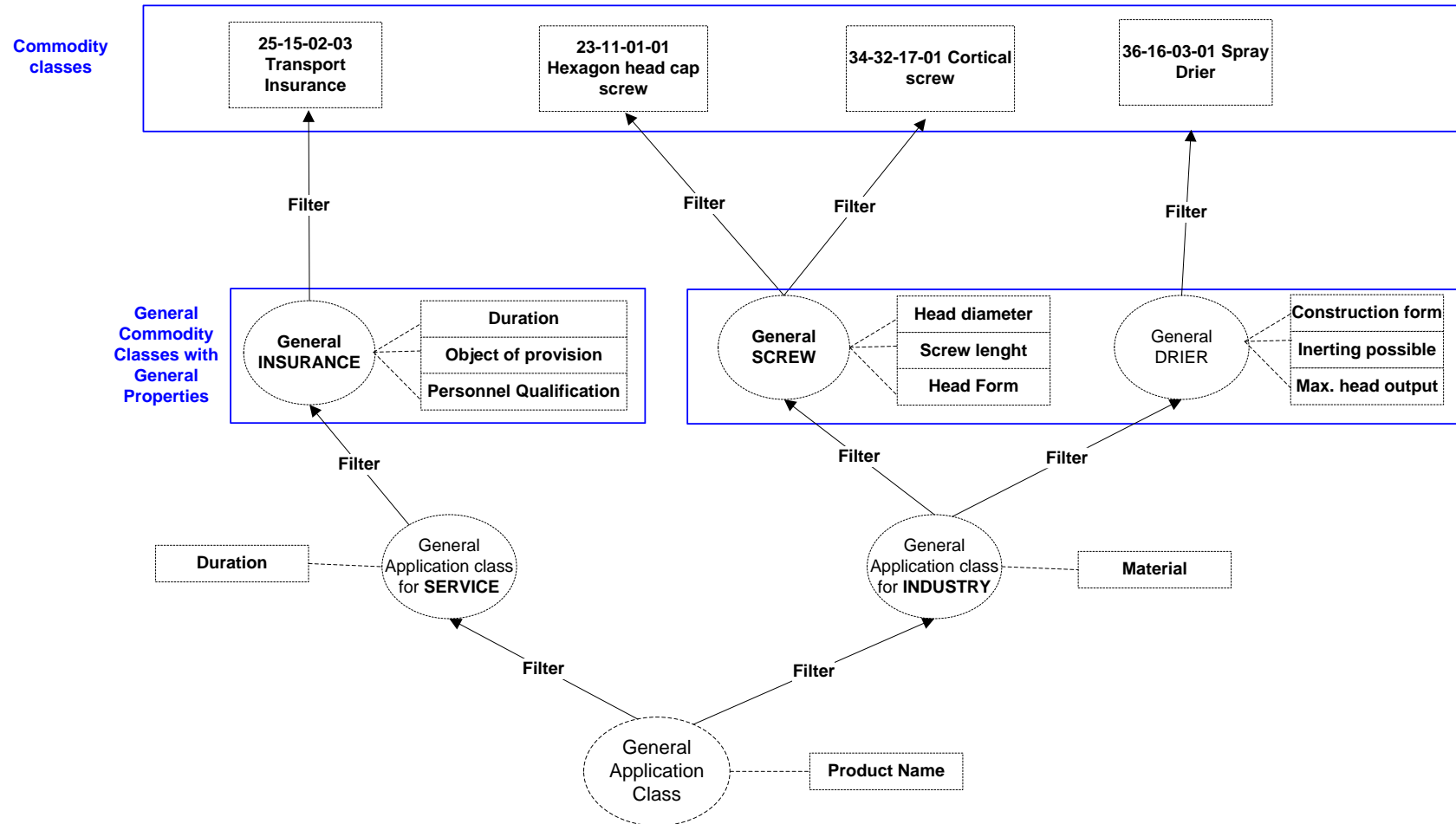


Figure 5: eCI@ss Data Model (Second step)

4.3 Aspects

An important step for the application of the new data model of eCl@ss is the categorisation of the properties through aspects. The categorisation of properties is a helpful mechanism to optimise information processing in eCl@ss. For each Application Class its properties can be categorised into administrative, commercial and technical aspects. Aspects are independent from each other, and each property is related directly to its corresponding aspects. Table 3 illustrates the property sets according to some specific types of screws. The right column shows the **Property Categories** grouping the properties of the selected screws into e.g. **Administrative Properties**, **Technical Properties** etc.

No	Property set	Aspects		Property category
1	BAA001003 - Manufacturer name		1.1 General	Administrative Properties
2	BAA002002 - Product type description			
3	BAA059003 - Supplier product number			
4	BAD847002 - Manufacturer product number			
5	BAA316003 - Product name			
6	BAA271003 - EAN code			
7	BAA899001 - Order supplement code			
8	BAA900002 - Order supplement according to standard			
9	BAB010001 - Publication date (year-month)			
10	BAB165002 - standard letter to the standard number			
11	BAB542001 - Supplier name			
12	BAB637002 - Product class			
13	BAE162001 - Requirement in accordance with		1.2 Medical	
14	BAJ012003 - Pharmaceutical central number			
15	BAJ013002 - Health Industry Barcode		3.1 General	
16	BAA929002 - Product class in accordance with norm			
17	BAA932002 - Key width			
18	BAA936001 - Tolerance information in accordance with norm			
19	BAB072002 - Tolerance			
20	BAB101002 - Surface protection			
21	BAB112001 - Material in accordance with norm			
22	BAB150001 - Surface protection in accordance with norm			
23	BAB664004 - Material			
24	BAA898002 - Drive quantity			
25	BAA919001 - Screw length			
26	BAA997001 - Thread length			
27	BAA907001 - Thread diameter			
28	BAA908002 - Thread direction			
29	BAA909003 - Thread pitch at nut end			
30	BAA914001 - Width of screw head			
31	BAA916001 - Head diameter of screw			
32	BAA917002 - Head form			
33	BAA918001 - Position of thread coating			
34	BAA922001 - Length of thread coating			
35	BAA930001 - Shaft diameter of the screw			
36	BAB090001 - Head form pursuant to standard			
37	BAB093001 - Head length of screw			
38	BAB162001 - Height of head			
39	BAB341001 - Thread size			
40	BAB618001 - Thread design according to standard letter			
41	BAB166002 - Max. perm. lower deviation of nominal diameter			
42	BAE452001 - Max. distance to D1			
43	BAA901001 - Thread size of screwed plug	3.2.2 Specific		
44	BAA902001 - Thread size of nut end			
45	BAA905002 - Thread diameter threaded end			
46	BAA910002 - Design of insertion end			
47	BAA920001 - Length of threaded end			
48	BAA921001 - Length of nut end			
49	BAA923001 - Length of thread coating at screw end			
50	BAA924001 - Length of thread coating at nut end			
51	BAA935001 - Width of ligament			

Table 3: Aspects and Property Categories for Screw group¹⁴

Figure 6 illustrates the mapping of the flat structure which has been shown in Table 3 to a hierarchical structure given by the inheritance hierarchy. This result in a hierarchical organisation of the properties belonging to one aspect.

¹⁴ More details available in paper: Reusch P., Garcia E., Communication of the Scientific Advisory Board of eCI@ss No 2. (2009) - Harmonisation of classes and property sets in critical commodity classes of eCI@ss.

The properties in the 'General Aspects' are the properties of the 'General Application Classes', and the others content the properties of the 'General Commodity Classes' and 'Specific Commodity Classes'.

In addition we have introduced the 'Commercial Aspects' as an example, which includes properties like price, delivery terms, units of trade, etc.

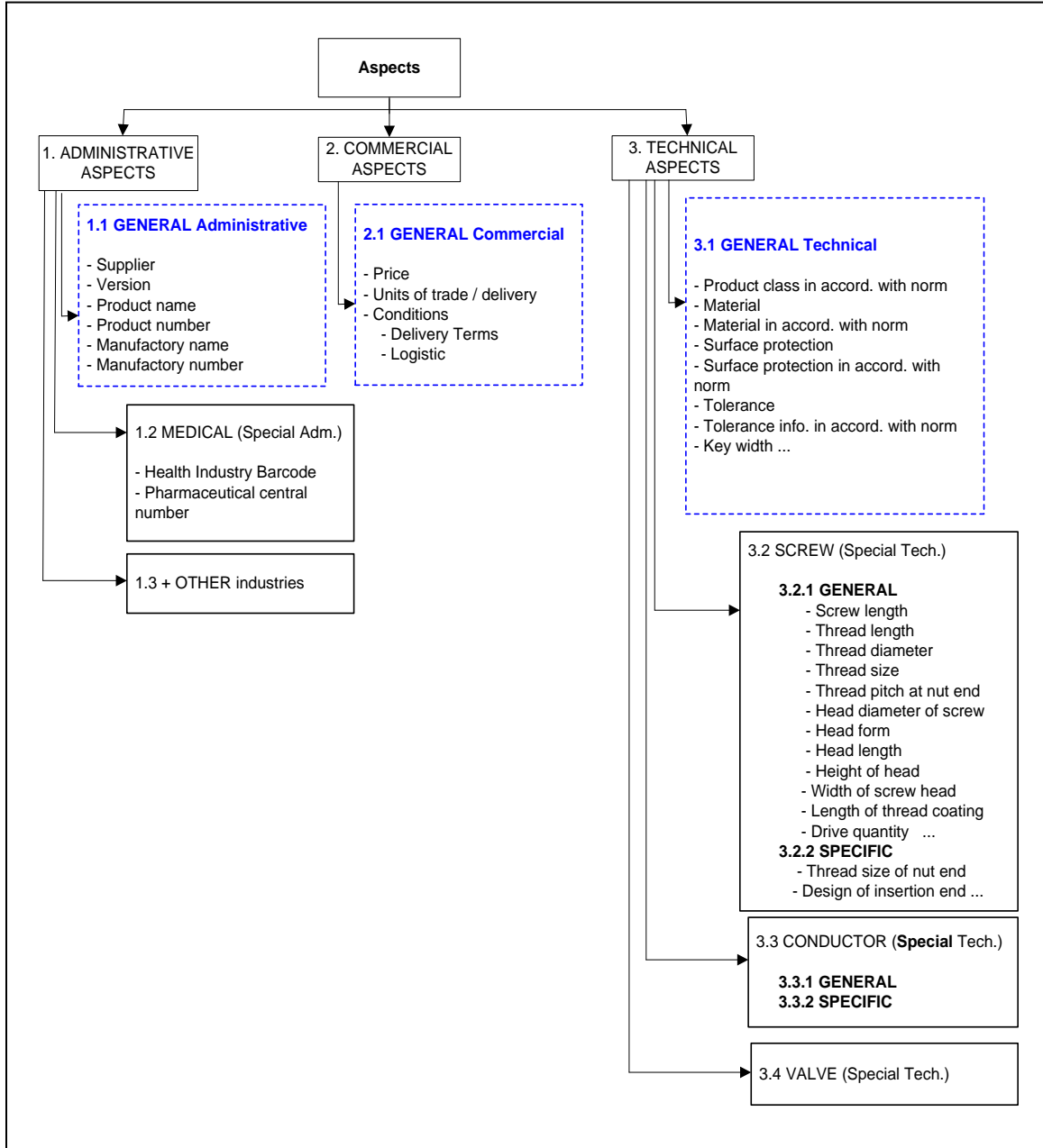


Figure 6: Aspects as additional classification of properties

According to the schema illustrated in Figure 6, the properties of e.g. *Cortical Screw* can be categorised by General Administrative, e.g. 'Product name' and Specific Administrative Aspects 'Medical', e.g. 'Health Industry Barcode'. The Specific Administrative Aspects can be distinguished by the Industry.

Figure 7 and Figure 8 illustrate in a detailed and compact version, the relation between Aspects and Properties regarding the commodity class 'Screw'. It shows how properties classified in different 'Aspects' are related to the commodity classes. For example the property 'Material' in the General Technical Aspect is related to the General Application Class or the property 'Head Diameter of Screw' categorised as Special Technical Aspect 'Screw' is related to the General Class 'Screw' with General Properties. Finally the property 'Health Industry Barcode' categorised in the Special Administrative Aspect 'Medical' is related to the specific properties of the Specific Application Class 'Cortical Screw'.

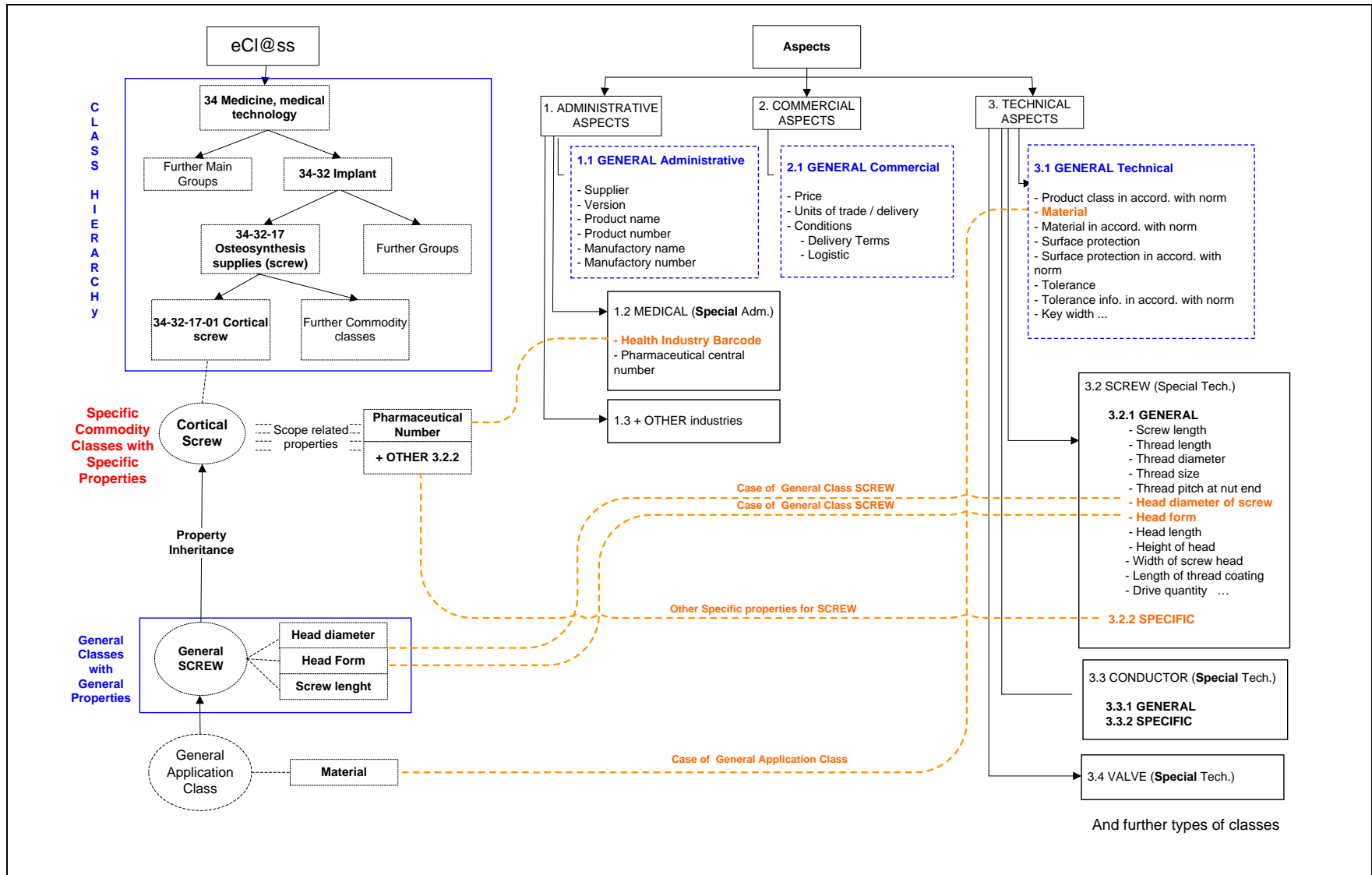


Figure 7: Relation between Aspects and Properties (Detailed Version)

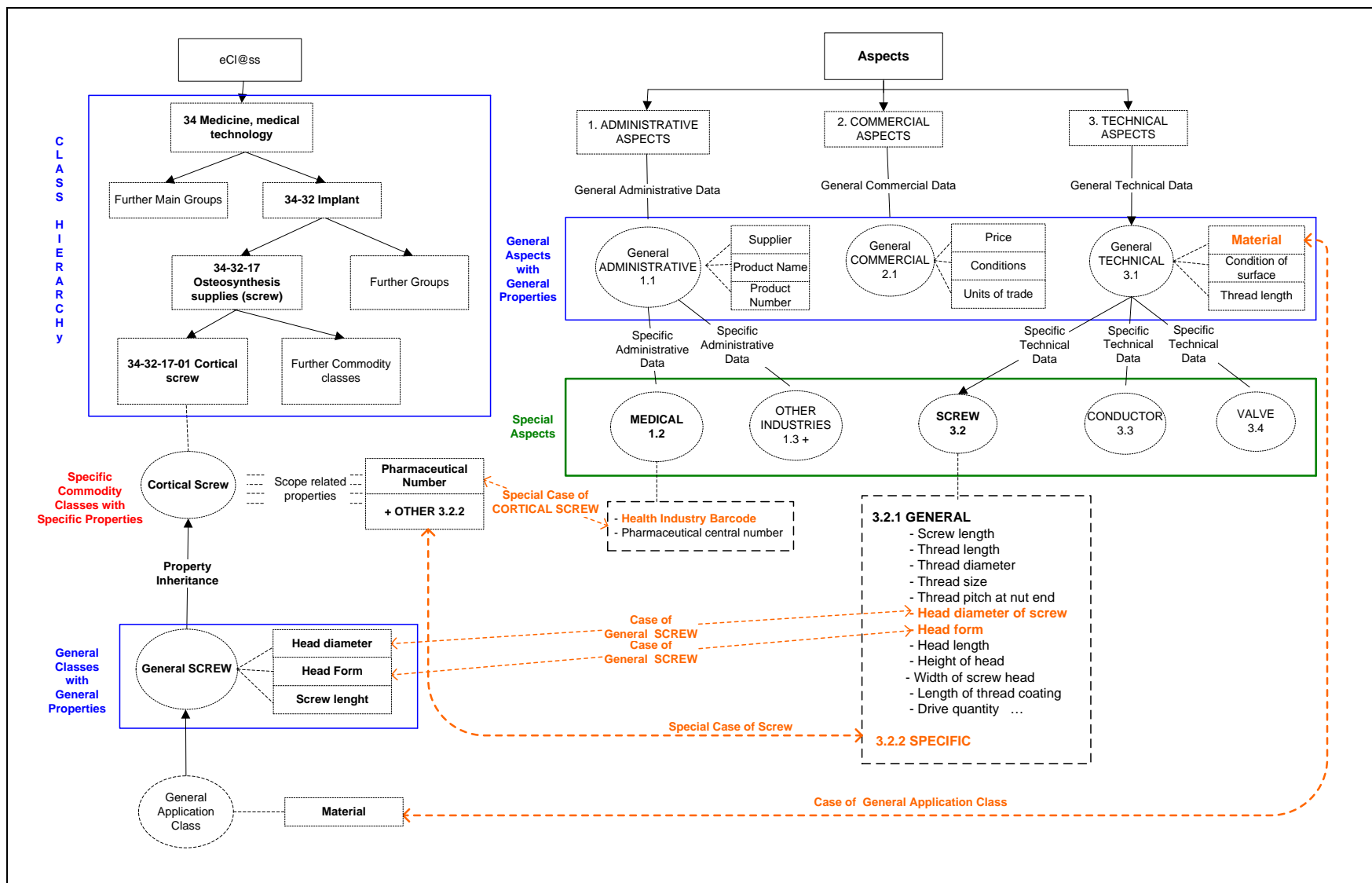


Figure 8: Relation between Aspects and Properties (Compact Version)

5. Estimated reduction in the number of properties for “Screw and Drier group”

5.1 SCREW Group

General Classes like for example, *Screw*¹⁵, can reduce the number of properties assigned to classes by inheriting the properties to the different hierarchical levels.

In the case of the ‘Screw group’ we consider 34 classes related to screw. 20 of them are related to normal screws and 14 to medical screws.

Normal Screw

Nr.	coded name	preferred name	Total No. of Properties assigned to normal Screws
1	21131721	Pressure screw (standardized tool parts, tool and die)	6
2	23110101	Hexagon head cap screw	34
3	23110102	Fillister head screw	33
4	23110103	Countersunk screw	33
5	23110106	Saucer-head screw	33
6	23110110	Special screw	35
7	23110111	Wood screw	35
8	23110112	Sheet metal screw	33
9	23110113	Screw, not flatly surface-mounted, outer drive	33
10	23110114	Dowel screw (with head)	35
11	23110116	Knurled thumb screw	30
12	23110117	Screw (self-tapping)	33
13	23110118	Drilling screw	32
14	23110119	Cap screw (no wrenching configuration specified)	29
15	23110121	Half-countersunk screw	6
16	23110190	Screw (with head, unclassified)	6
17	23110303	Screw bolt	33
18	23110601	Thumb screw	24
19	23110690	Screw (special, unclassified)	6
20	23250312	Levelling screw	6

Table 4: Total number of properties assigned to ‘Normal Screw’

¹⁵ More details available in: Garcia, E. (2009): Harmonisation of property sets in critical commodity classes of eCI@ss, Project Thesis, European Master in Project Management, Dortmund/Bilbao.

Table 4 shows the 20 classes related to normal screws and the total number of assigned properties to each class. Some of these classes are well developed. This means, that for example, 'Hexagon head cap screw' has assigned 34 properties, thus it is defined quite detailed by properties.

On the other hand there are some classes that have only a few properties that are not sufficient to distinguish them from other classes. For example, 'Pressure screw', 'Half-countersunk screw', 'Screw (with head unclassified)', 'Levelling screw' etc. have only 6 assigned property sets. 5 properties out of these are basic properties and the additional one is the 'EAN code'.

Beside these basic properties there exist further properties which are often assigned to a lot of classes. Table 5 and Table 6 show the set of properties assigned to each commodity class for a normal screw. Analysing the set of properties assigned to the 20 commodity classes representing normal screws we can see that there are overlapping properties in the well developed classes. On the one hand there are classes that have common properties and on the other hand there exist only few classes with unique properties like for example, 'Dowel screw', 'Screw bolt' and 'Thumb Screw'. Out of the total amount of 48 properties there are 11 unique properties assigned to one of these 3 classes.

No	Property set	1	2	3	4	5	6	7	8	9	10
		Pressure screw (standardized tool parts, tool and die)	Hexagon head cap screw	Fillister head screw	Countersunk screw	Saucer-head screw	Special screw	Wood screw	Sheet metal screw	Screw, not flatly surface-mounted, outer drive	Dowel screw (with head)
		21-13-17-21	23-11-01-01	23-11-01-02	23-11-01-03	23-11-01-06	23-11-01-10	23-11-01-11	23-11-01-12	23-11-01-13	23-11-01-14
1	BAA001003 - Manufacturer name	x	x	x	x	x	x	x	x	x	x
2	BAA002002 - Product type description	x	x	x	x	x	x	x	x	x	x
3	BAA059003 - Supplier product number	x	x	x	x	x	x	x	x	x	x
4	BAD847002 - Manufacturer product number	x	x	x	x	x	x	x	x	x	x
5	BAA316003 - Product name	x	x	x	x	x	x	x	x	x	x
6	BAA271003 - EAN code	x	x	x	x	x	x	x	x	x	x
7	BAA899001 - Order supplement code		x	x	x	x	x	x	x	x	x
8	BAA900002 - Order supplement according to standard		x	x	x	x	x	x	x	x	x
9	BAB010001 - Publication date (year-month)		x	x	x	x	x	x	x	x	x
10	BAB165002 - Standard letter to the standard number		x	x	x	x	x	x	x	x	x
11	BAB637002 - Product class		x	x	x	x	x	x	x	x	x
12	BAE162001 - Requirement in accordance with		x	x	x	x	x	x	x	x	x
13	BAA929002 - Product class in accordance with norm		x	x	x	x	x	x	x	x	x
14	BAA932002 - Key width		x	x	x	x		x	x	x	x
15	BAA936001 - Tolerance information in accordance with norm		x	x	x	x	x	x	x	x	x
16	BAB072002 - Tolerance		x	x	x	x	x	x	x	x	x
17	BAB101002 - Surface protection		x	x	x	x	x	x	x	x	x
18	BAB112001 - Material in accordance with norm		x	x	x	x	x	x	x	x	x
19	BAB150001 - Surface protection in accordance with norm		x	x	x	x	x	x	x	x	x
20	BAB664004 - Material		x	x	x	x	x	x	x	x	x
21	BAA898002 - Drive quantity		x		x	x		x	x	x	x
22	BAA919001 - Screw length		x	x	x	x	x	x	x	x	x
23	BAA997001 - Thread length		x	x	x	x	x	x	x	x	
24	BAA907001 - Thread diameter		x	x	x	x	x	x	x	x	x
25	BAA908002 - Thread direction		x	x	x	x	x	x	x	x	x
26	BAA909003 - Thread pitch at nut end		x	x	x	x	x	x	x	x	x
27	BAA914001 - Width of screw head						x	x			x
28	BAA916001 - Head diameter of screw		x	x	x	x	x	x	x	x	x
29	BAA917002 - Head form		x	x	x		x	x	x		
30	BAA918001 - Position of thread coating		x	x	x	x	x	x	x	x	x
31	BAA922001 - Length of thread coating		x	x	x	x	x	x	x	x	x
32	BAA930001 - Shaft diameter of the screw					x	x				x
33	BAB090001 - Head form pursuant to standard		x	x			x	x	x		
34	BAB093001 - Head length of screw						x	x		x	
35	BAB162001 - Height of head		x	x	x	x	x	x	x	x	x
36	BAB341001 - Thread size		x	x	x	x	x			x	x
37	BAB618001 - Thread design according to standard letter		x	x	x	x	x	x	x	x	x
38	BAA901001 - Thread size of screwed plug										
39	BAA902001 - Thread size of nut end										
40	BAA905002 - Thread diameter threaded end										
41	BAA910002 - Design of insertion end										
42	BAA920001 - Length of threaded end										
43	BAA921001 - Length of nut end										
44	BAA923001 - Length of thread coating at screw end										
45	BAA924001 - Length of thread coating at nut end										
46	BAA935001 - Width of ligament										
47	BAB166002 - Max. perm. lower deviation of nominal diameter										x
48	BAE452001 - Max. distance to D1										x
		6	34	33	33	33	35	35	33	33	35

Table 5: Properties assigned to 'Normal Screw'

No	Property set	11	12	13	14	15	16	17	18	19	20
		Knurled thumb screw	Screw (self-tapping)	Drilling screw	Cap screw (no wrenching configuration specified)	Half-countersunk screw	Screw (with head, unclassified)	screw bolt	Thumb screw	Screw (special, unclassified)	Levelling screw
		23-11-01-16	23-11-01-17	23-11-01-18	23-11-01-19	23-11-01-21	23-11-01-90	23-11-03-03	23-11-06-01	23-11-06-90	23-25-03-12
1	BAA001003 - Manufacturer name	x	x	x	x	x	x	x	x	x	x
2	BAA002002 - Product type description	x	x	x	x	x	x	x	x	x	x
3	BAA059003 - Supplier product number	x	x	x	x	x	x	x	x	x	x
4	BAD847002 - Manufacturer product number	x	x	x	x	x	x	x	x	x	x
5	BAA316003 - Product name	x	x	x	x	x	x	x	x	x	x
6	BAA271003 - EAN code	x	x	x	x	x	x	x	x	x	x
7	BAA899001 - Order supplement code	x	x	x	x			x			
8	BAA900002 - Order supplement according to standard	x	x	x	x			x			
9	BAB010001 - Publication date (year-month)	x	x	x	x			x	x		
10	BAB165002 - Standard letter to the standard number	x	x	x	x			x	x		
11	BAB637002 - Product class	x	x	x	x			x			
12	BAE162001 - Requirement in accordance with	x	x	x	x			x	x		
13	BAA929002 - Product class in accordance with norm	x	x	x	x			x			
14	BAA932002 - Key width		x	x							
15	BAA936001 - Tolerance information in accordance with norm	x	x	x	x			x	x		
16	BAB072002 - Tolerance	x	x	x	x			x	x		
17	BAB101002 - Surface protection	x	x	x	x			x	x		
18	BAB112001 - Material in accordance with norm	x	x	x	x			x	x		
19	BAB150001 - Surface protection in accordance with norm	x	x	x	x			x	x		
20	BAB664004 - Material	x	x	x	x			x	x		
21	BAA898002 - Drive quantity		x	x							
22	BAA919001 - Screw length	x	x	x	x			x	x		
23	BAA997001 - Thread length	x			x				x		
24	BAA907001 - Thread diameter	x	x	x	x			x	x		
25	BAA908002 - Thread direction	x	x	x	x			x	x		
26	BAA909003 - Thread pitch at nut end	x	x	x	x			x	x		
27	BAA914001 - Width of screw head										
28	BAA916001 - Head diameter of screw	x	x	x	x						
29	BAA917002 - Head form		x	x							
30	BAA918001 - Position of thread coating	x	x	x	x			x			
31	BAA922001 - Length of thread coating	x	x	x	x						
32	BAA930001 - Shaft diameter of the screw										
33	BAB090001 - Head form pursuant to standard		x	x							
34	BAB093001 - Head length of screw								x		
35	BAB162001 - Height of head	x	x	x	x				x		
36	BAB341001 - Thread size	x	x								
37	BAB618001 - Thread design according to standard letter	x	x	x	x			x	x		
38	BAA901001 - Thread size of screwed plug							x			
39	BAA902001 - Thread size of nut end							x			
40	BAA905002 - Thread diameter threaded end							x			
41	BAA910002 - Design of insertion end							x			
42	BAA920001 - Length of threaded end							x			
43	BAA921001 - Length of nut end							x			
44	BAA923001 - Length of thread coating at screw end							x			
45	BAA924001 - Length of thread coating at nut end							x			
46	BAA935001 - Width of ligament								x		
47	BAB166002 - Max. perm. lower deviation of nominal diameter										
48	BAE452001 - Max. distance to D1										
		30	33	32	29	6	6	33	24	6	6

Table 6: Properties assigned to 'Normal Screw'

Table 7 shows the 11 different unique properties assigned to one of the three classes

No	Property set	Dowel screw (with head)	screw bolt	Thumb screw
		23-11-01-14	23-11-03-03	23-11-06-01
1	BAA901001 - Thread size of screwed plug		x	
2	BAA902001 - Thread size of nut end		x	
3	BAA905002 - Thread diameter threaded end		x	
4	BAA910002 - Design of insertion end		x	
5	BAA920001 - Length of threaded end		x	
6	BAA921001 - Length of nut end		x	
7	BAA923001 - Length of thread coating at screw end		x	
8	BAA924001 - Length of thread coating at nut end		x	
9	BAA935001 - Width of ligament			x
10	BAB166002 - Max. perm. lower deviation of nominal diameter	x		
11	BAE452001 - Max. distance to D1	x		

Table 7: Unique properties in normal Screw group

The main issue is to reduce the number of properties in the overlapping classes (see tables Table 5 and Table 6) and take them out from the 1st level (Specific properties for specific screw) to the 2nd level (General classes with general properties) and 3rd level (General application class). The total number of properties can not be reduced; only the number of properties assigned to classes. The reduction of properties assigned to classes can be executed via application classes and inheritance classes.

The hierarchy of the application classes define some aspects. Table 8 illustrates the 48 properties of the normal Screw group and the categorisation of proposed aspects for these properties.

Property category	Aspects		No	Property set	Properties assigned to classes
Administrative Properties	1.1 General		1	BAA001003 - Manufacturer name	20
			2	BAA002002 - Product type description	20
			3	BAA059003 - Supplier product number	20
			4	BAD847002 - Manufacturer product number	20
			5	BAA316003 - Product name	20
			6	BAA271003 - EAN code	20
			7	BAA899001 - Order supplement code	14
			8	BAA900002 - Order supplement according to standard	14
			9	BAB010001 - Publication date (year-month)	15
			10	BAB165002 - Standard letter to the standard number	15
			11	BAB637002 - Product class	14
			12	BAE162001 - Requirement in accordance with	15
Technical properties	3.1 General		13	BAA929002 - Product class in accordance with norm	14
			14	BAA932002 - Key width	10
			15	BAA936001 - Tolerance information in accordance with norm	15
			16	BAB072002 - Tolerance	15
			17	BAB101002 - Surface protection	15
			18	BAB112001 - Material in accordance with norm	15
			19	BAB150001 - Surface protection in accordance with norm	15
			20	BAB664004 - Material	15
	3.2 Screw	3.2.1 General	21	BAA898002 - Drive quantity	9
			22	BAA919001 - Screw length	15
			23	BAA997001 - Thread length	11
			24	BAA907001 - Thread diameter	15
			25	BAA908002 - Thread direction	15
			26	BAA909003 - Thread pitch at nut end	15
			27	BAA914001 - Width of screw head	3
			28	BAA916001 - Head diameter of screw	13
			29	BAA917002 - Head form	8
			30	BAA918001 - Position of thread coating	14
			31	BAA922001 - Length of thread coating	13
			32	BAA930001 - Shaft diameter of the screw	3
			33	BAB090001 - Head form pursuant to standard	7
			34	BAB093001 - Head length of screw	4
			35	BAB162001 - Height of head	14
			36	BAB341001 - Thread size	9
			37	BAB618001 - Thread design according to standard letter	15
		3.2.2 Specific	38	BAA901001 - Thread size of screwed plug	1
			39	BAA902001 - Thread size of nut end	1
			40	BAA905002 - Thread diameter threaded end	1
			41	BAA910002 - Design of insertion end	1
			42	BAA920001 - Length of threaded end	1
			43	BAA921001 - Length of nut end	1
			44	BAA923001 - Length of thread coating at screw end	1
			45	BAA924001 - Length of thread coating at nut end	1
			46	BAA935001 - Width of ligament	1
			47	BAB166002 - Max. perm. lower deviation of nominal diameter	1
			48	BAE452001 - Max. distance to D1	1

Table 8: Aspects and Property Categories for Normal Screw

Table 9 shows the inheritance of properties into the 2nd and 3rd level and the relative percentage of reduction of properties. The relative reduction is calculated by the sum of the number of properties of the 2nd and 3rd level divided by the total number of properties assigned to the class. As shown in this table there exist classes with specific properties which will not be reduced to 100%. The shaded items are excluded from the calculation because they contain to classes which only provide 6 basic properties but no technical properties.

Nr.	coded name	preferred name	Total No. of Properties assigned to normal Screws	Upper level	2nd Level	Lower level	Relative % of reduction
				1st Level		3rd level	
				No. of Specific properties for specific Screw	No. of General properties for general Screw	General application Class	
1	21131721	Pressure screw (standardized tool parts, tool and die)	6	0	0	6	100.00%
2	23110101	Hexagon head cap screw	34	0	17	17	100.00%
3	23110102	Fillister head screw	33	0	16	17	100.00%
4	23110103	Countersunk screw	33	0	16	17	100.00%
5	23110106	Saucer-head screw	33	0	16	17	100.00%
6	23110110	Special screw	35	0	18	17	100.00%
7	23110111	Wood screw	35	0	18	17	100.00%
8	23110112	Sheet metal screw	33	0	16	17	100.00%
9	23110113	Screw, not flatly surface-mounted, outer drive	33	0	16	17	100.00%
10	23110114	Dowel screw (with head)	35	2	16	17	94.29%
11	23110116	Knurled thumb screw	30	0	13	17	100.00%
12	23110117	Screw (self-tapping)	33	0	16	17	100.00%
13	23110118	Drilling screw	32	0	15	17	100.00%
14	23110119	Cap screw (no wrenching configuration specified)	29	0	12	17	100.00%
15	23110121	Half-countersunk screw	6	0	0	6	100.00%
16	23110190	Screw (with head, unclassified)	6	0	0	6	100.00%
17	23110303	Screw bolt	33	8	8	17	75.76%
18	23110601	Thumb screw	24	1	10	13	95.83%
19	23110690	Screw (special, unclassified)	6	0	0	6	100.00%
20	23250312	Levelling screw	6	0	0	6	100.00%

97.73%

Sum of relevant properties divided by the number of relevant classes	36	4	15	17
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Table 9: Relative percentage of reduction per class

Hereby we assume that a well developed commodity class for normal screw should have about 36 properties. Then we assume that a commodity class of normal screw group has to contain at least 4 specific properties, 15 general properties for general screw and 17 properties of general application classes.

Calculation of the Relative Percentage of Reduction for ‘Normal Screw’

To calculate the total reduction of properties in the group normal screw there are calculated at first the total number of properties which are needed in the old scheme without the hierarchy of application classes. From the figures in the tables above we can conclude that on the average there are four specific properties in a commodity class, i.e. four properties are defined at that level per class and not inherited from an upper class. In addition, at the general technical level we count 15 properties, and at the general level we count 17 properties. All of them have to be associated to any of the 20 classes. Thus, for the 20 classes we get 720 properties (20 classes multiplied by (4 properties – 1st Level, 15 properties – 2nd Level, 17 properties – 3rd Level); see Figure 9)).

$$20 \times (17 + 15 + 4) = 720$$

On the other hand, when having a property inheritance for application classes, we need to assign the properties of the general and the general technical level only once to a class. Thus, we get the formula of Figure 9 which results in a total number of property assignments to classes of 112. From 720 assigned properties in the first model remain 112 property assignments to classes. That means that 15% properties remain and the reduction of properties assigned to classes is 85%.

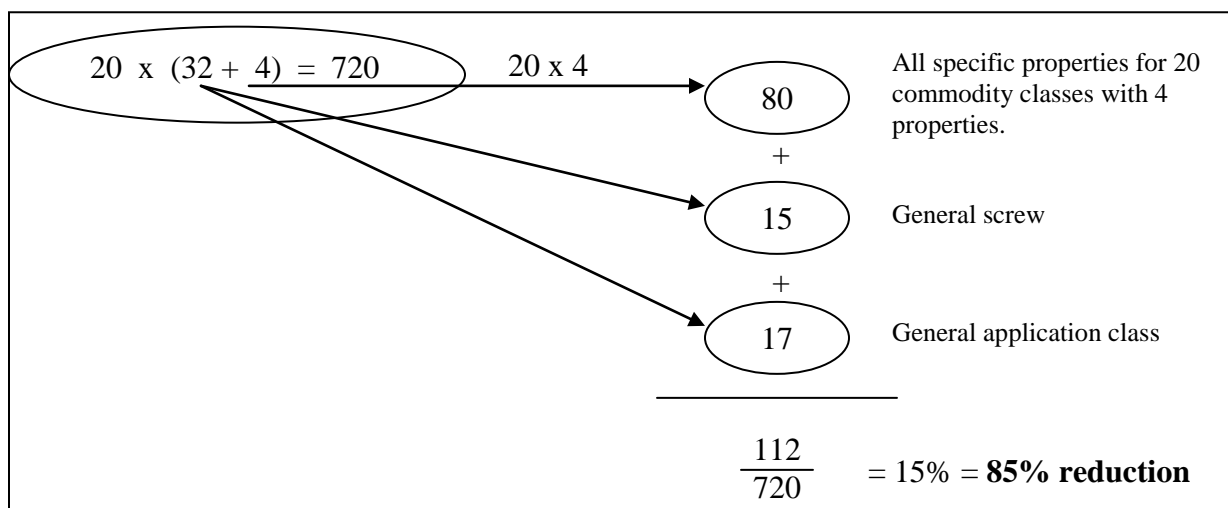


Figure 9: Relative percentage of reduction per group

Figure 10 shows a detailed illustration of the relative reduction per group in the case of “normal screw”.

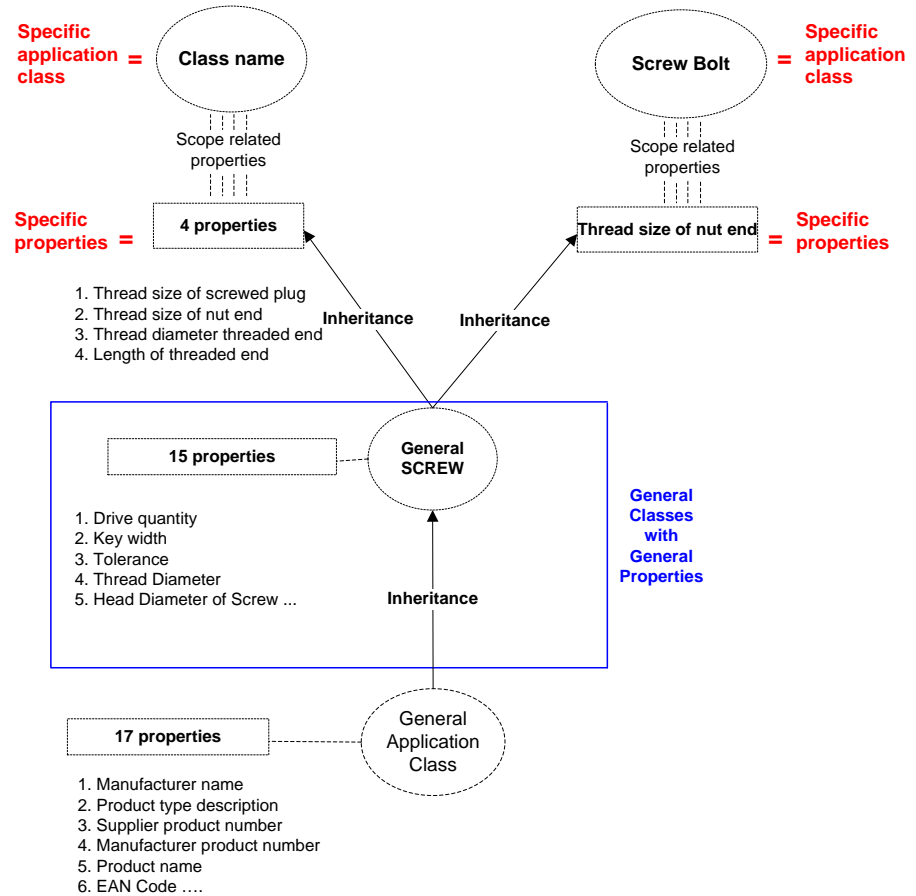
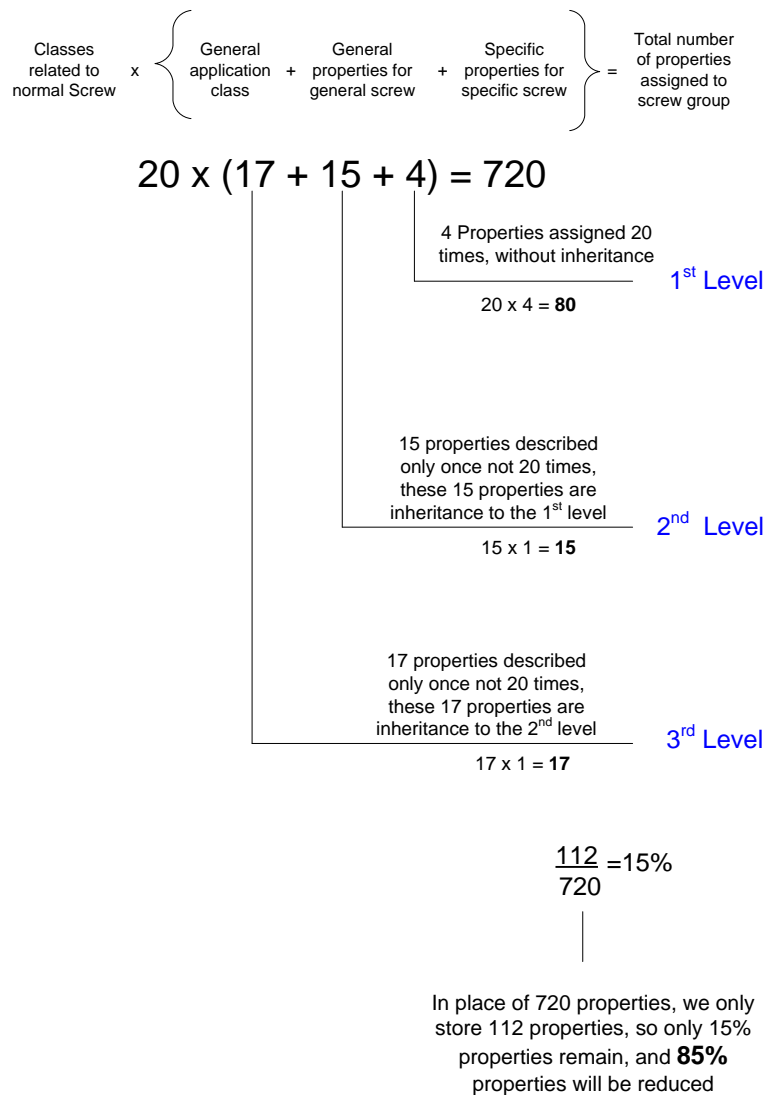


Figure 10: Property reduction by inheritance (SCREW)

5.2 DRIER Group

The estimation of reduction is based on the number of properties for the relevant well developed classes. Figure 11 illustrates the reduction of property assignment by the property inheritance model for Drier Group in detail.

Level 3 contains 18 properties, 5 defaults plus 13 properties which have been taken down from level 2. These 18 properties are the basic descriptions for all commodities, properties in '*General Application Class*' are applicable to every commodity in eCI@ss. Instead of copy such properties to each class, we only apply them once at this level but not 35 times (35 relevant classes). These 18 properties will be inherited to level 2. The introduction of '*General Application Class*' reduces the number of properties at classes; it also allows an easy extension of the basic property sets.

At level 2 – '*General Drier with General Properties*', 82 properties have been taken into account, which are overlapping across 35 commodity classes and be considered as common attributes for '*Drier Group*'¹⁶. Same as '*General Application Class*', properties at this level only apply once instead of 35 times. The number of overlapping properties has been reduced in the greatest extent, 95% properties have been reduced at this level, and only 5% properties remain eventually.

The specific properties at level 1 are specifically assigned to the classes and not inherited from an upper level. Thus, they need to be assigned to each commodity class individually, and in other words, repeated properties are inevitable. Different from previous two levels, properties at this level must be applied 35 times.

Properties at level 2 and level 3 are applicable to the relevant classes, we can take the number of properties to the respective level directly for calculation, however, the number of specific properties at level 1 differ from class to class, therefore we take the sum of

¹⁶ More details available in: Dong, H. (2009): Detection of commodity classes in eCI@ss based on the analysis of properties, Project Thesis, European Master in Project Management, Dortmund/Bilbao.

relevantly well-developed properties divided by the number of relevant classes – 51 as the presumed average number of specific properties.

The total number of properties assigned to all the 35 '**Drier**' related classes is 5285, which is the sum of '**General Application Class**', '**General Drier with General Properties**', and '**Specific Drier with Specific properties**' for each commodity class multiplied by the whole '**Drier Group**' – 35 relevant classes.

The introduction of such three levels allows an inheritance of properties from the upper level, properties at level 2 and 3 only apply once to the '**Drier Group**'¹⁷, this makes the reduction significantly. The total number of properties actually assigned to the '**Drier Group**' after the introduction of three levels is 1885, which is the sum of '**General Application Class**', and '**General Drier with General Properties**', plus 1785 specific properties for all the 35 '**Drier**' related classes (51 presumed number of specific properties multiplied by 35 relevant classes).

In its conclusion, 1885 data entries replace of 5285 properties. Numerically, only 36% properties remain, and 64% properties will be reduced.

¹⁷ More details available in: Dong, H. (2009): Detection of commodity classes in eCI@ss based on the analysis of properties, Project Thesis, European Master in Project Management, Dortmund/Bilbao.

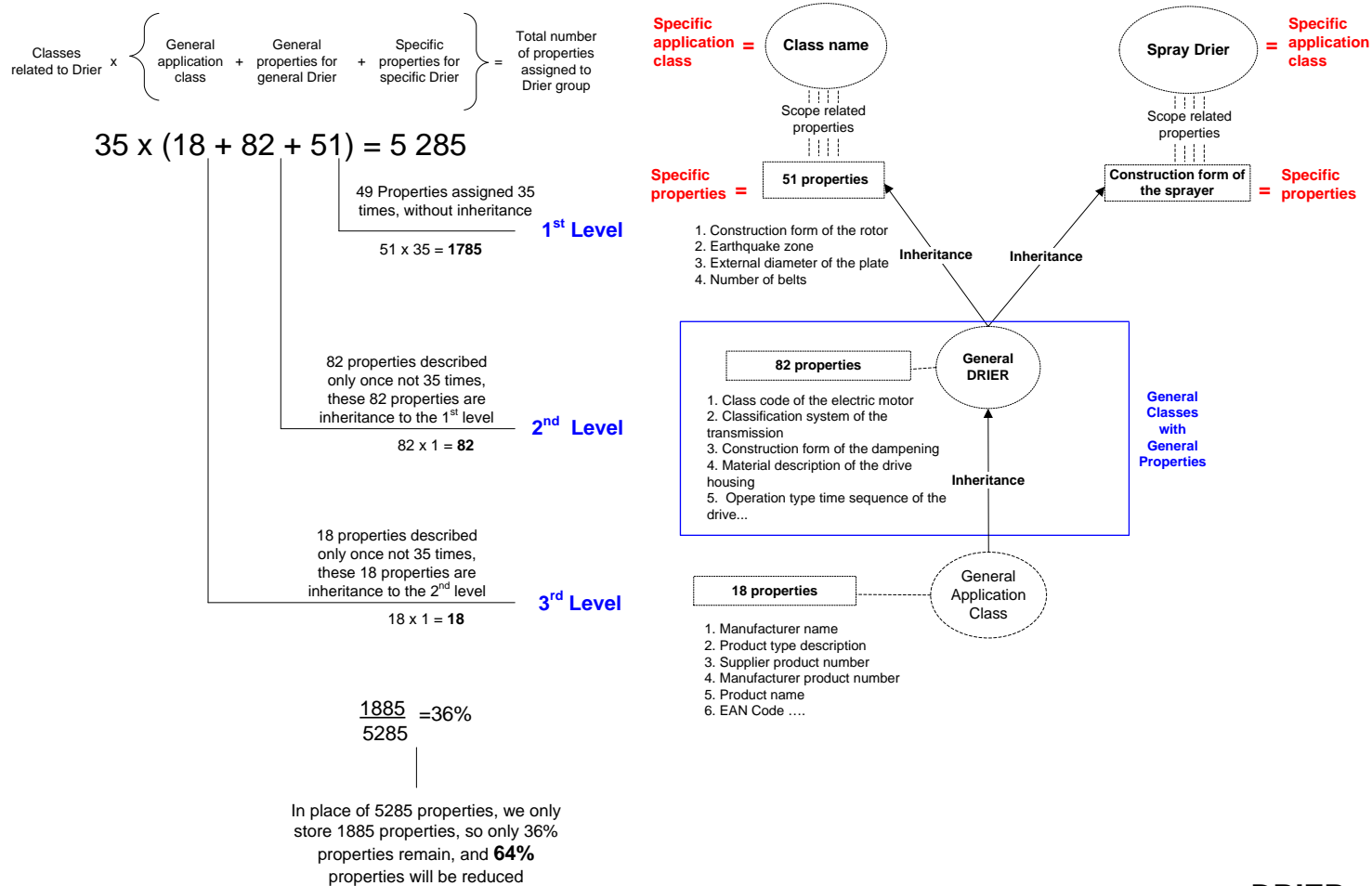


Figure 11: Property reduction by inheritance (DRIER)

6. General estimations on the reduction of properties

A Rough calculation on the reduction of properties can start like this:

There are more than 30,000 commodity classes in eCl@ss. A well developed commodity class should have about 30 properties.

In the old eCl@ss approach for that we would need about 1,000,000 assignments of individual properties to individual commodity classes.

If we assume that in average we can introduce general commodity classes (like general screw) that cover about 10 commodity classes, then we will have 3,000 general classes.

If we assume that 80% of the properties can be assigned to the general classes, and inherited to the commodity classes, the number of individual assignments of properties will go down from about 1,000,000 to about 200,000.

If we assume that 50% of the properties that could be assigned to general classes could be transferred to general properties, then 100,000 assignments can be managed by inheritance. The assignments of properties will go down to about 100,000

The total reduction of assigned properties could be reduced by roughly 90% according to this rough calculation.

Of course the various segments have different approaches in the development of properties. In the service segment there are so many overlapping properties that could be removed from individual commodity classes. That could lead to much higher reduction of properties assigned to commodity classes.

This rough calculation is based on experience in the application of properties in various segments.

7. Conclusions

The application of the new data model in the way described before – or in a similar way - would lead to the following benefits:

1. Less work in handling properties
2. Real opportunity to link all those classes with totally insufficient property set to a general class which provides them automatically by inheritance all those properties that are really needed to support e-commerce according to the strategies of eCl@ss
3. Better quality of property definitions
4. Less mistakes in property definitions
5. Harmonisation of classes and properties.

A data base with 1,000,000 separate assignments of properties is quite hard be managed. Underdeveloped class descriptions cannot be adapted in an efficient way.

The application of the new data model is not only a question of some improvements in class descriptions – it is also linked to the question: “How can eCl@ss survive and proceed?”

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